AstroCube: An Asteroid Prospecting CubeSat Mission, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

Busek, in partnership with Arizona State University (ASU), proposes to develop a robotic resource prospecting mission to a near-Earth asteroid using a 6U CubeSat, nicknamed "AstroCube". This ambitious mission is enabled by Busek's iodine-fueled BIT-3 RF ion propulsion system that can deliver ~1mN of thrust and ~2200sec of total Isp with 65W nominal input power. With 1.6kg of solid iodine propellant onboard, the BIT-3 thruster will provide AstroCube approximately 3.1km/s of delta-V maneuverability to rendezvous with the target, Asteroid 2001 GP2, during its next closest Earth approach in October 2020. The 6U CubeSat platform is chosen due to its low cost and ease of access to ride-share opportunity on GEO-bound upper stages, as well as on the upcoming NASA SLS demonstration missions. The AstroCube mission will leverage a unique deep-space 6U CubeSat bus with ion propulsion, currently being co-developed by Busek and Morehead State University (MSU) under NASA's Lunar IceCube flight program. The proposed mission will encompass several technology innovations, including compact science instruments and autonomous CONOPS, which are the focus of this Phase I development. A rad-tolerant, 1/4U sized camera-Lidar device will give AstroCube "eyes" to survey the asteroid and help with proximity navigation. Due to the asteroid? s weak gravitational field, the spacecraft will be required to use real-time depth image processing and its ion thruster to navigate around the asteroid during final approach to a low stationary altitude. Once such close proximity is reached, a 1U sized neutron spectrometer will be activated to characterize the abundance of hydrogen, which would indicate presence of water ice, by detecting slow-moving neutrons as they scatter off the asteroid's regolith from the bombardment of cosmic rays.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The AstroCube

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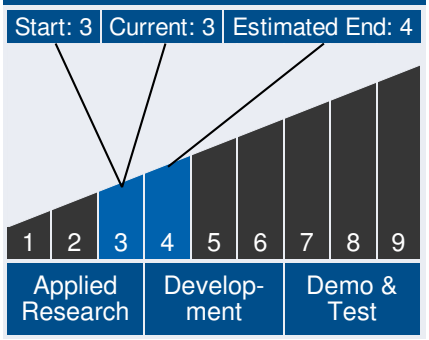
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

Continued on following page.

mission will be the first to utilize the MSU-Busek deep space 6U CubeSat bus with ion propulsion as an "off the shelf" product, signifying a rapid return of NASA?s current investment in such technology. In addition to demonstrate the spacecraft's ability to reach deep space destinations, the proposed instrument payloads will be crucial for NASA's CubeSat-class exploration missions in the future. Exploring our solar system with low-cost robotic/scout vehicles as precursors for human or science missions will benefit from these technology advancements. AstroCube's revolutionary iodine RF ion thruster enables CubeSats to fly beyond earth orbit and can be used in close proximity operations. The ultra-compact, 1/4U sized camera-Lidar will push the state-of-the-arts envelope by giving "depth vision" to CubeSats. The 1U sized neutron spectrometer will enable a multitude of resource prospecting mission with its ability to detect bulk hydrogen abundance in the top meter of asteroid regolith, which could lead to opportunities for In-Situ Resource Utilization (ISRU) types of mission to nearby celestial bodies.

To the commercial space industry:

Potential Non-NASA Commercial Applications: The market size for the AstroCube's bus-propulsion package and instruments is very large. Potential non-NASA customers include commercial human exploration and presence in space, commercial asteroid missions, DoD and commercial Earth Observation (EO) missions. Reconnaissance agencies also have indicated interest in such technologies for long-duration LEO missions.

Management Team *(cont.)*

Principal Investigator:

- Michael Tsay

Technology Areas

Primary Technology Area:
Human Exploration Destination Systems (TA 7)
└ In-Situ Resource Utilization (TA 7.1)
  └ Destination Reconnaissance, Prospecting, and Mapping (TA 7.1.1)

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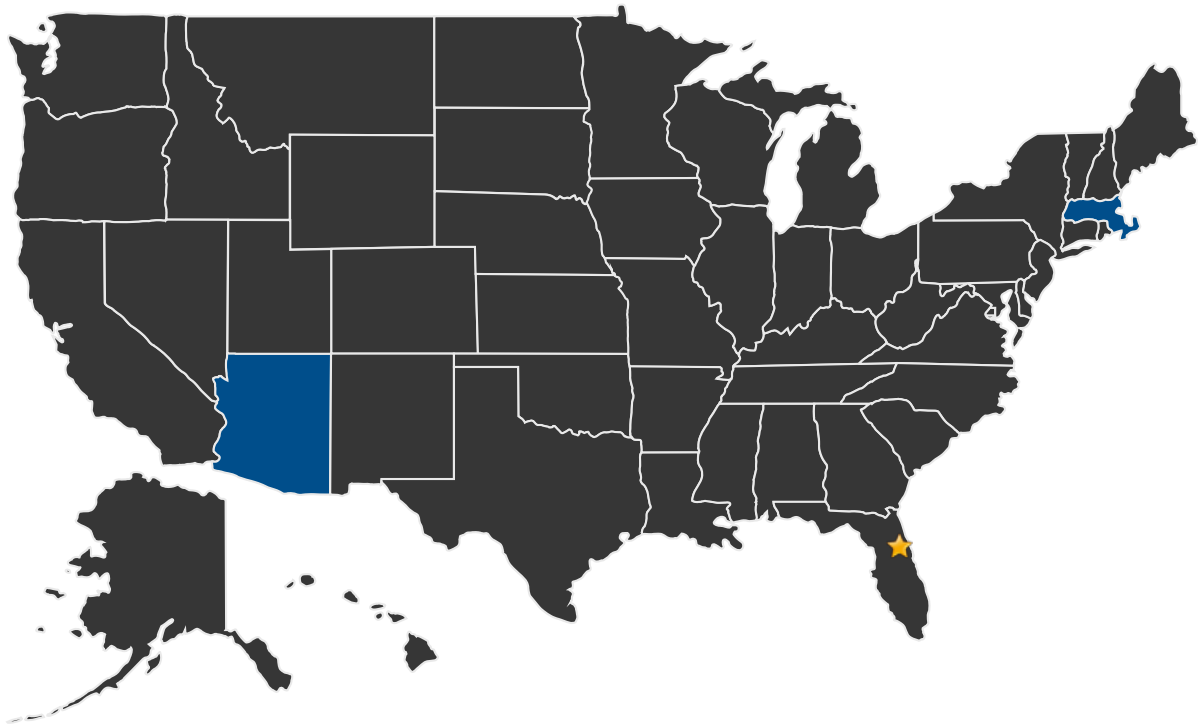
U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Kennedy Space Center

Other Organizations Performing Work:

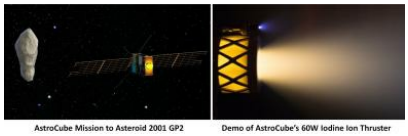
- Arizona State University
- Busek Company, Inc. (Natick, MA)

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23295)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

The AstroCube mission will be the first to utilize the MSU-Busek deep space 6U CubeSat bus with ion propulsion as an "off the shelf" product, signifying a rapid return of NASA?s current investment in such technology. In addition to demonstrate the spacecraft's ability to reach deep space destinations, the proposed instrument payloads will be crucial for NASA's CubeSat-class exploration missions in the future. Exploring our solar system with low-cost robotic/scout vehicles as precursors for human or science missions will benefit from these technology advancements. AstroCube's revolutionary iodine RF ion thruster enables CubeSats to fly beyond earth orbit and can be used in close proximity operations. The ultra-compact, 1/4U sized camera-Lidar will push the state-of-the-arts envelope by giving "depth vision" to CubeSats. The 1U sized neutron spectrometer will enable a multitude of resource prospecting mission with its ability to detect bulk hydrogen abundance in the top meter of asteroid regolith, which could lead to opportunities for In-Situ Resource Utilization (ISRU) types of mission to nearby celestial bodies.